The Need For Improved GIS Capabilities and an Overview of NEFSC Data on Fish Distribution, Hydrography and Seabed Habitat

Dr. Thomas Noji, Division Chief (presenter)
Steven Fromm, IT Specialist
Suellen Fromm, IT Specialist
John Manderson, Fisheries Research Biologist

Northeast Fisheries Science Center, Howard Marine Lab, Sandy Hook, NJ.

Abstract

The Northeast Fisheries Science Center possesses extensive databases with data on seasonal fish distribution by life-history stage, seabed characteristics including surficial geology and benthic fauna, plankton and hydrography. In order to facilitate current research on habitat-dependent fish recruitment, as well as to address other habitat-related issues such as the protection of cold-water corals and the spread of invasive species, it is important to further develop (or replace) our current GIS to include hydrographic and seabed data, as well as information on relevant human activities such as current and planned trawl effort and petroleum activities.

The need for improved GIS capabilities and an overview of NEFSC data on fish distribution, hydrography and seabed habitat

Note: This version has been modified for distribution. Several slides were removed from the original for proprietary reasons.

Dr. Thomas Noji, Steven Fromm, Suellen Fromm, John Manderson

Northeast Fisheries Science Center
James J. Howard Marine Sciences Laboratory
Sandy Hook, NJ

Thomas.noji@noaa.gov

- What do we need?
- What are the tasks?
- What do we want?
- What can we do?

NEFSC mission

Conduct ecosystem-based research and assessments of living marine resources and their environments in the Northeast Shelf ecosystem to

(a) promote recovery and long-term sustainability of fish stocks and protected species;

(b) restore and preserve habitats necessary to secure ecosystem health; and

(c) enhance and ensure long-term social and economic benefits to society from their use.

Ecosystems Processes Division

Understand the effects of environmental variability and human disturbances on fish and shellfish productivity relative to habitat.

- **Primary Objectives**
- 1. Identify and map marine habitat
- 2. Identify ecological processes and fish life histories relevant for understanding the importance of habitats for fish recruitment
- 3. Describe the impact of anthropogenic factors and environmental changes (broad temporal scale) on fish populations

Tasks

A. Promote recovery and long-term sustainability of fish stocks and protected species

-Map fish distribution

-Map fishing effort, e.g. VMS

-Ecosystem considerations in stock assessments

B. Restore and preserve habitats necessary to secure ecosystem health

-Provide information on Essential Fish Habitat to the Councils in the form of maps

-Map habitat types

-Map Habitat Areas of Particular Concern

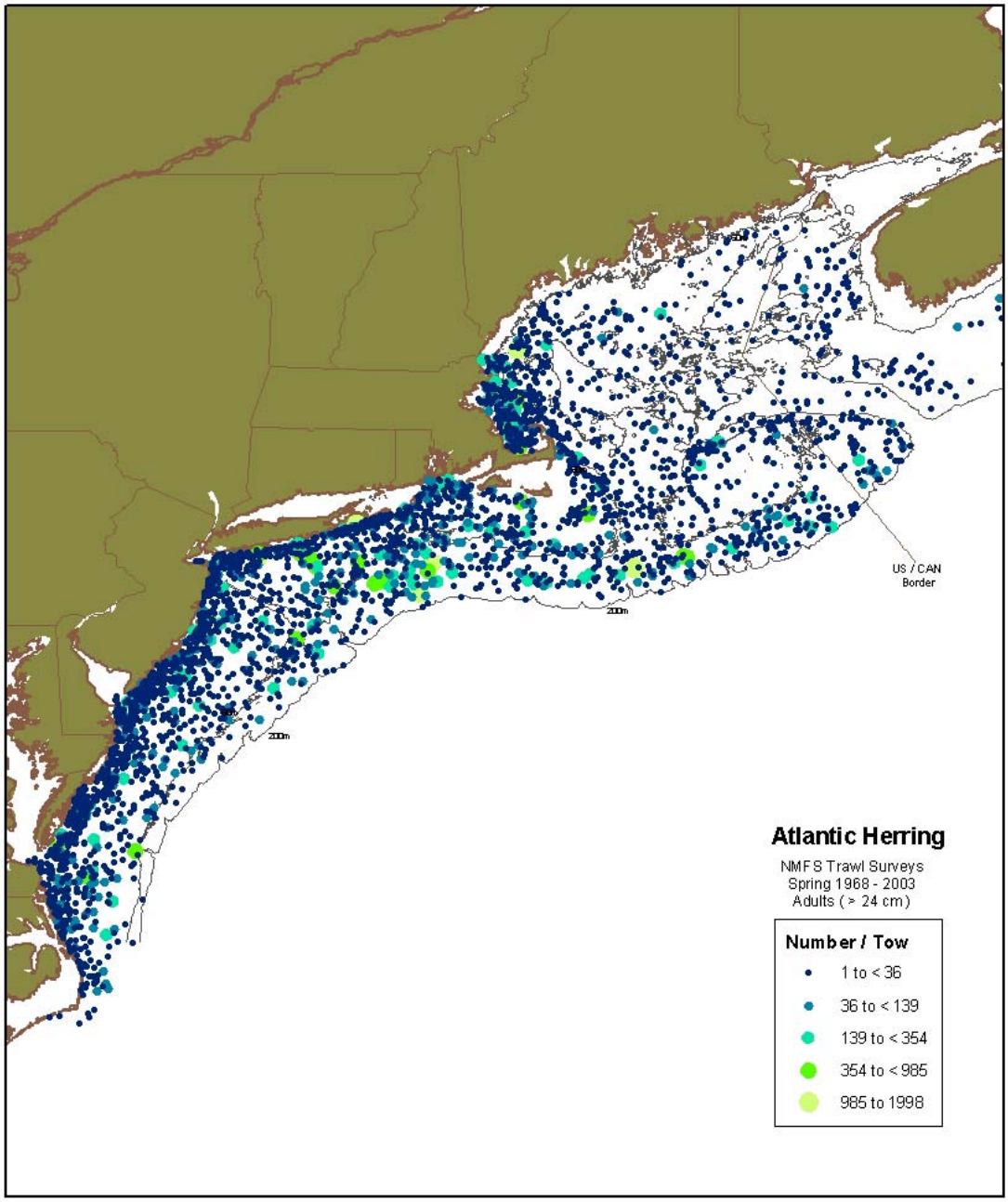
-Map threatening human activities

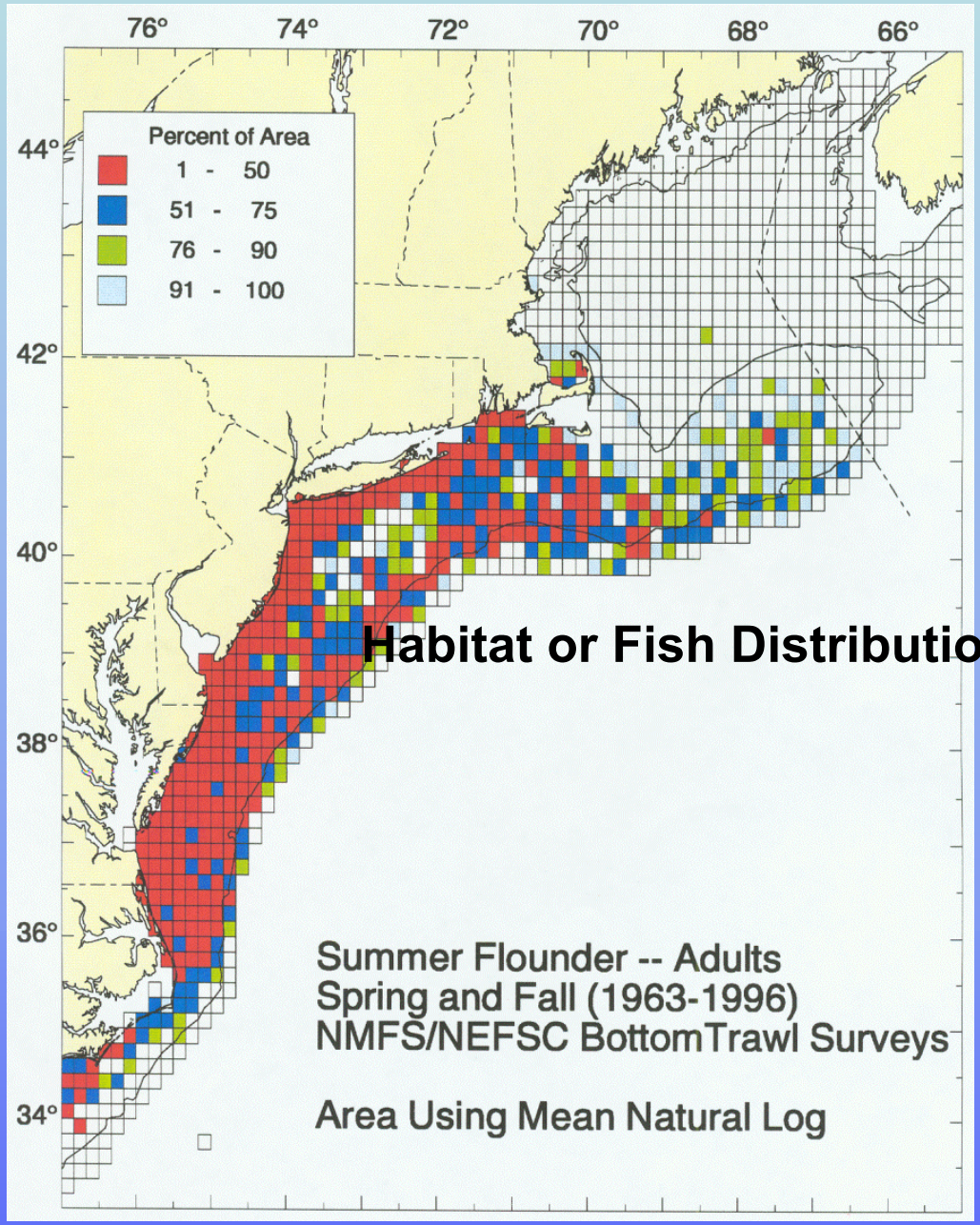
-Map current and proposed management actions, e.g. closures

C. Enhance and ensure long-term social and economic benefits to society from their use

- -Map “services” by geographical location, e.g. petroleum, fisheries, pharmaceuticals, ecotourism, etc.
- -Map ecosystem services (structure, composition, function)

Atlantic Herring
NEFSC Bottom Trawl Survey
Spring/Adults





An example of a 10-minute squares map used in designating summer flounder EFH.

Stock Assessment Process

- Wait for Paul Rago!

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B. Restore and preserve habitats necessary to secure ecosystem health

-Provide information on Essential Fish Habitat to the Councils in the form of maps

-Map habitat types (implies ability to classify)

-Map Habitat Areas of Particular Concern

-Map human and natural activities affecting habitats

-Map current and proposed management actions, e.g. closures

C. Enhance and ensure long-term social and economic benefits to society from their use

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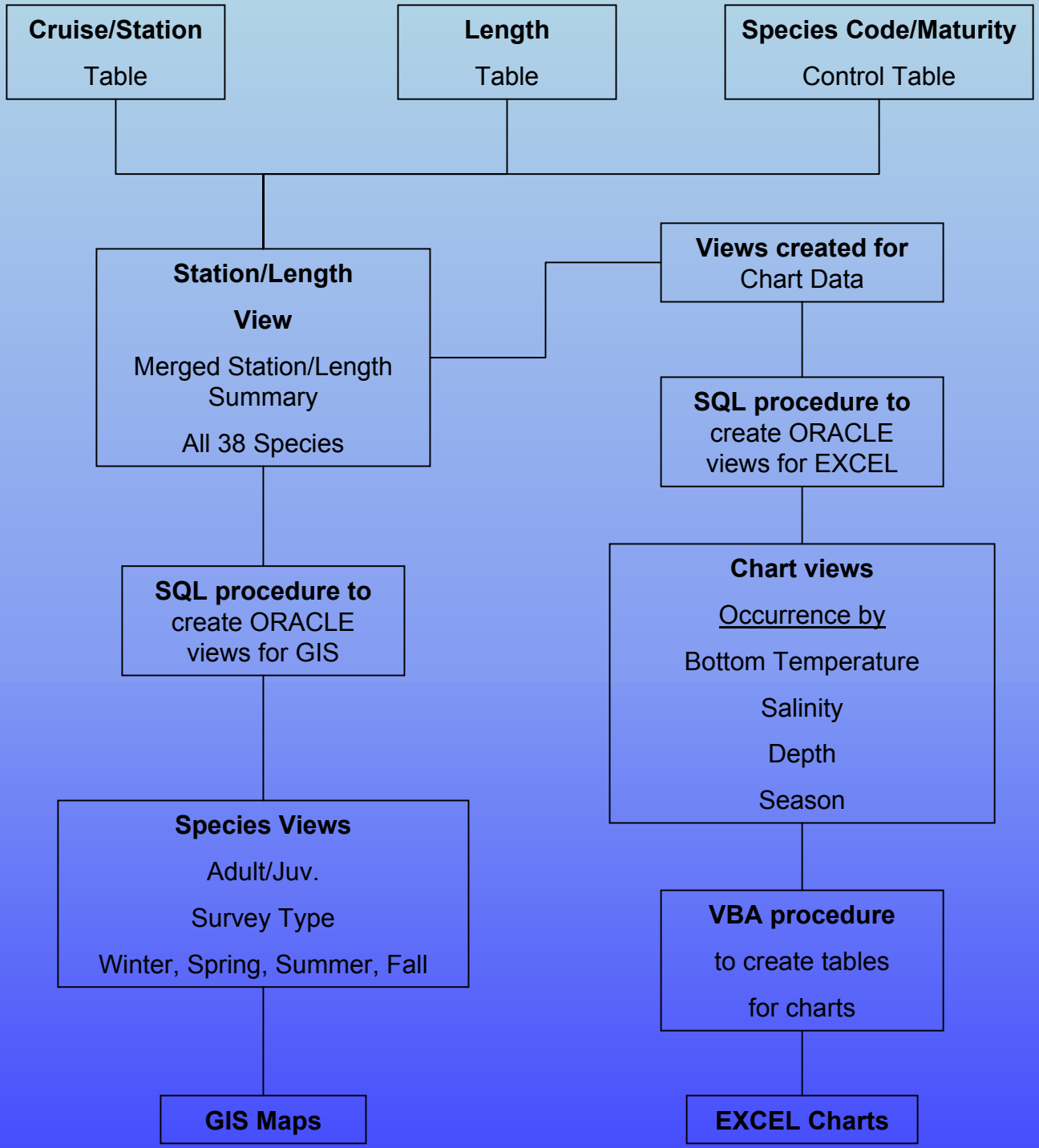
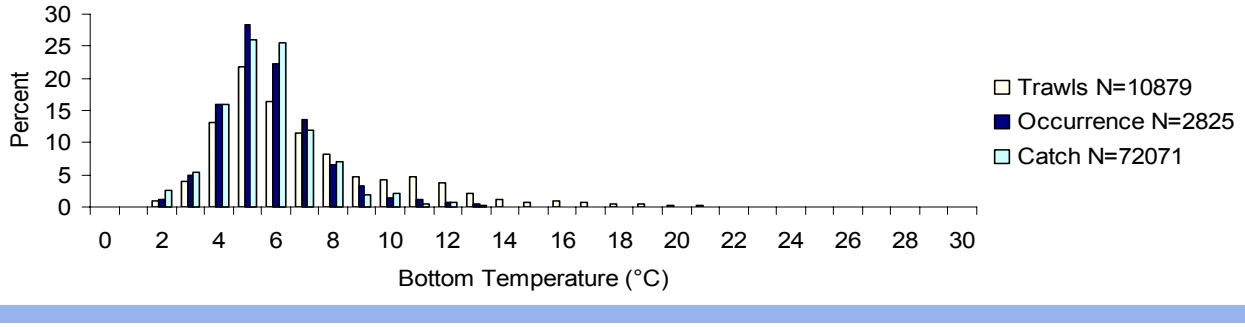
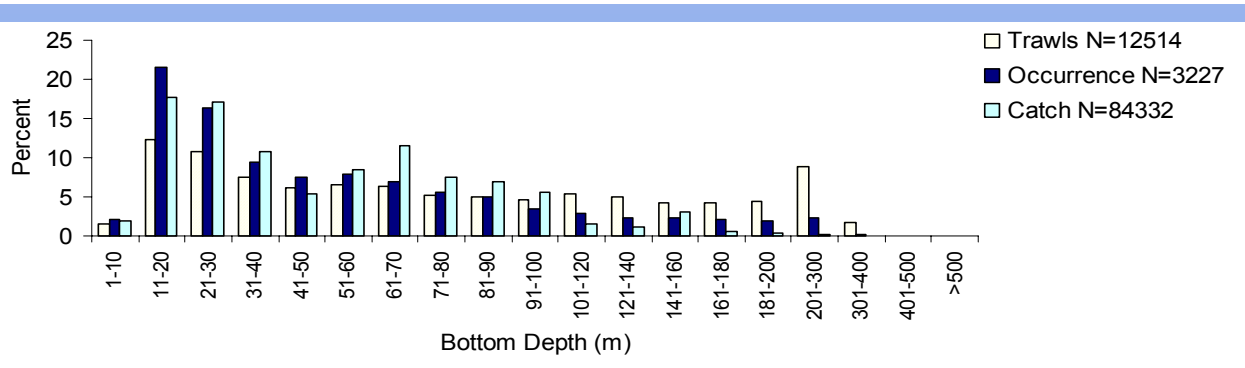
ESSENTIAL FISH HABITAT GIS DATABASE

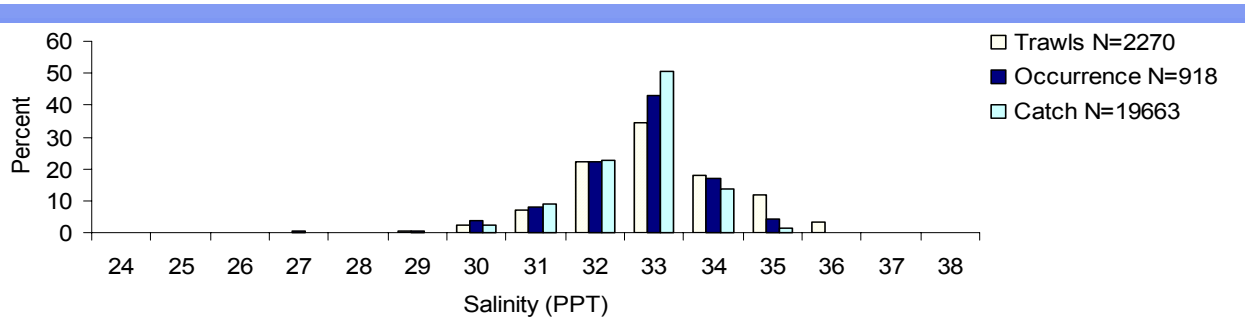


Source data is provided by the NEFSC Woods Hole lab via ORACLE snapshots. Local subset tables are created based on certain qualifying criteria, i.e. survey type, year, gear and species.

Atlantic Herring
NEFSC Bottom Trawl Survey
Spring/Adults





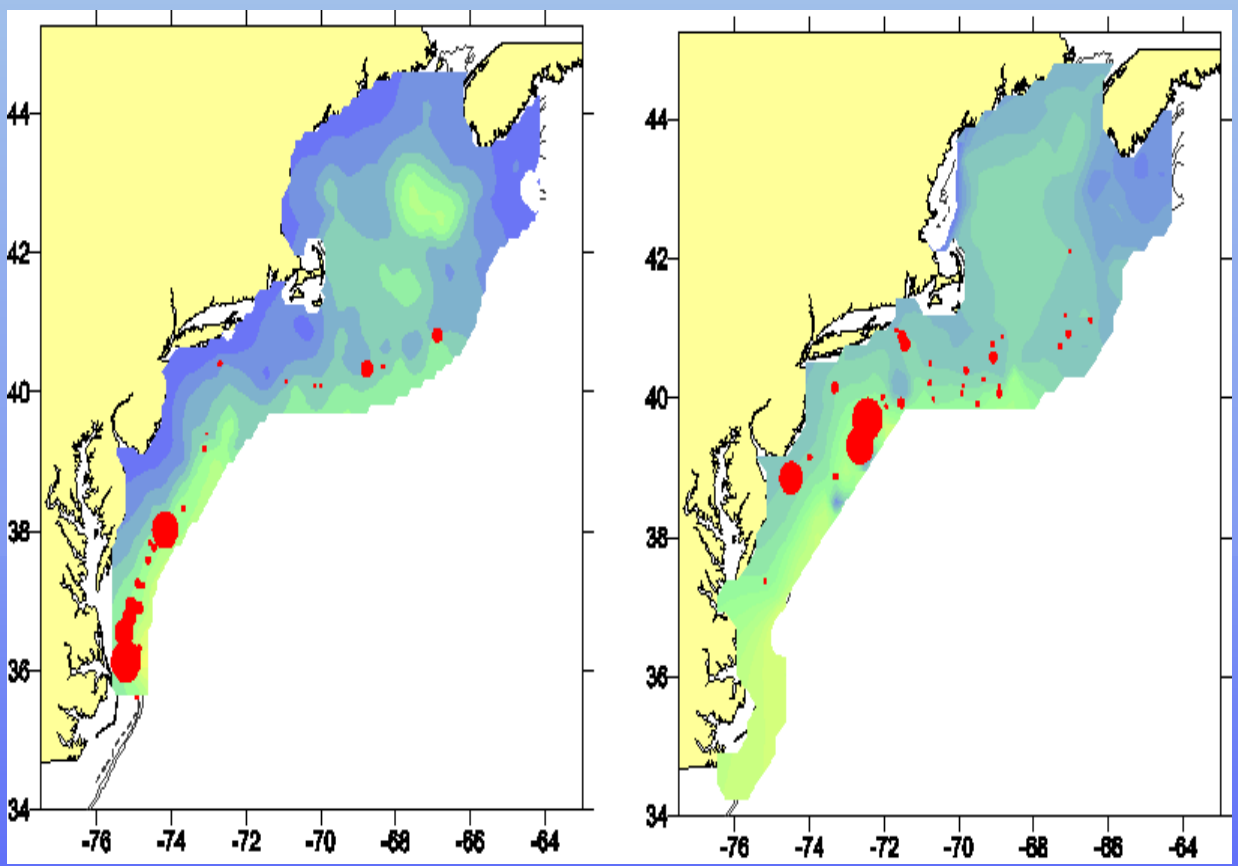


Distributions of adult Atlantic herring and trawls based on spring NEFSC bottom trawl surveys (Temperature and Depth: 1968-2003, all years combined; Salinity: 1991-2003, all years combined). Light bars show the distribution of all the trawls, dark bars show the distribution of all trawls in which Atlantic herring were caught and medium bars show, within each interval, the percentage of the total number of Atlantic herring caught.

Atlantic Mackerel and SST

Spring 1968

Spring 1974



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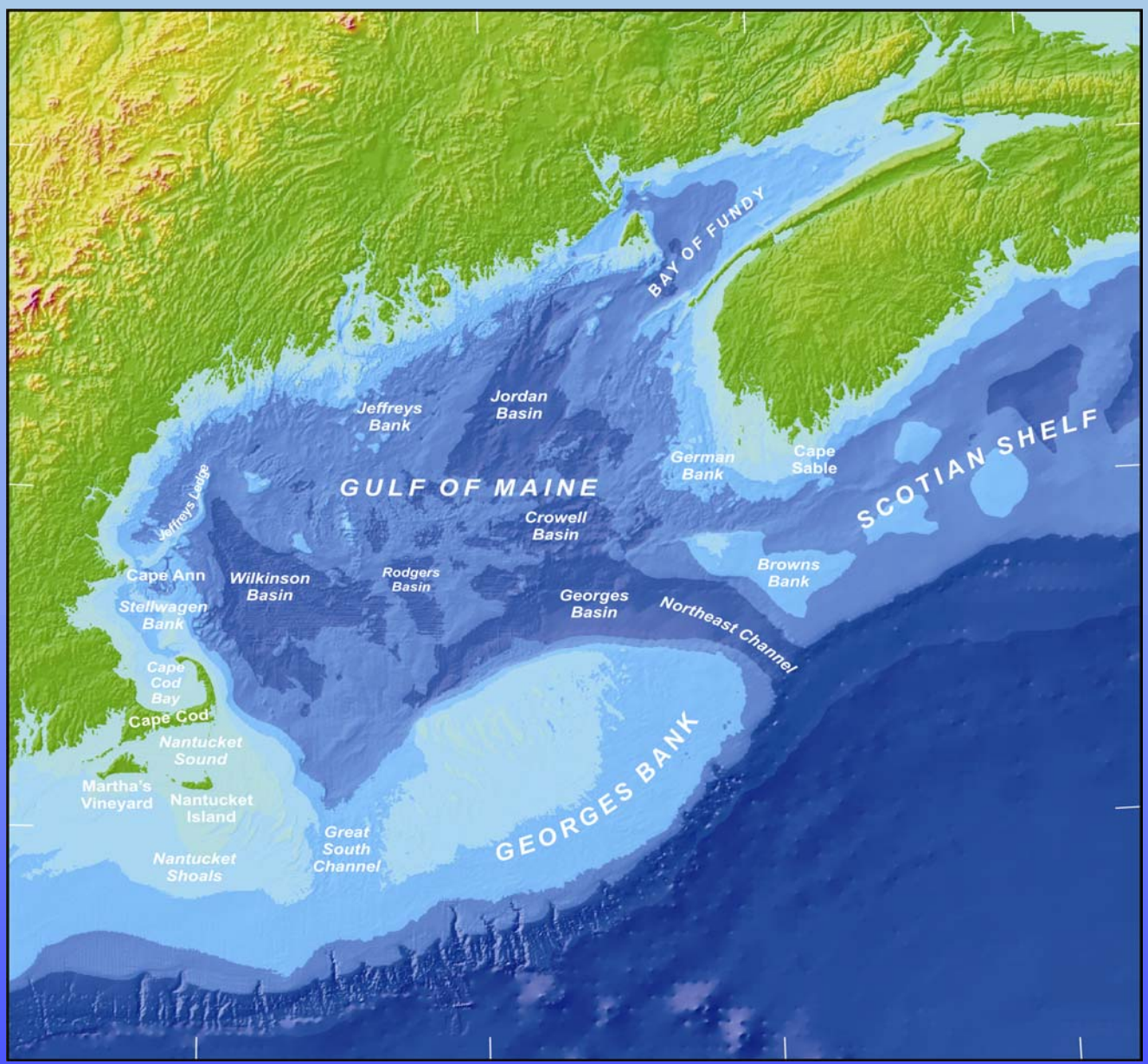
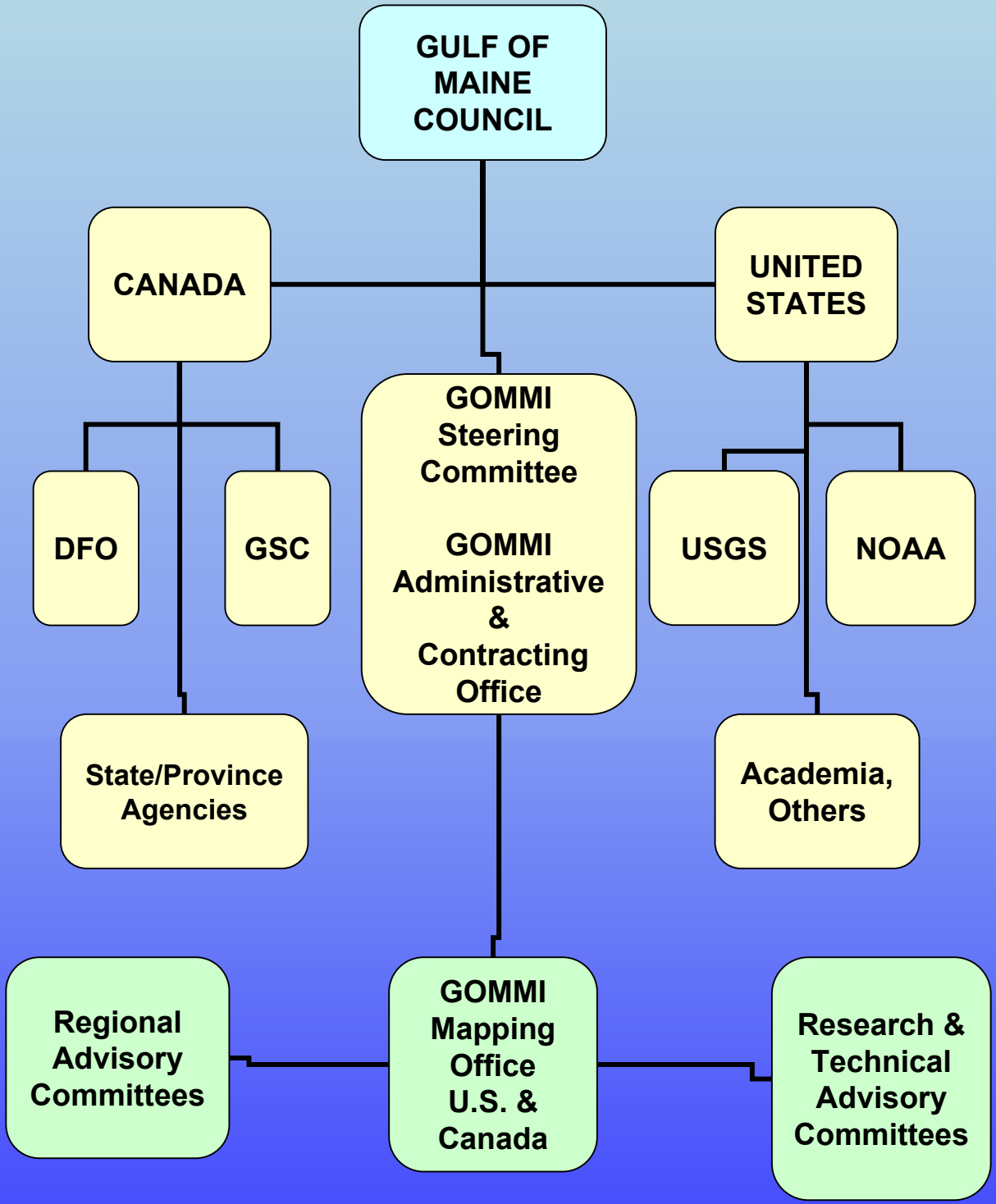
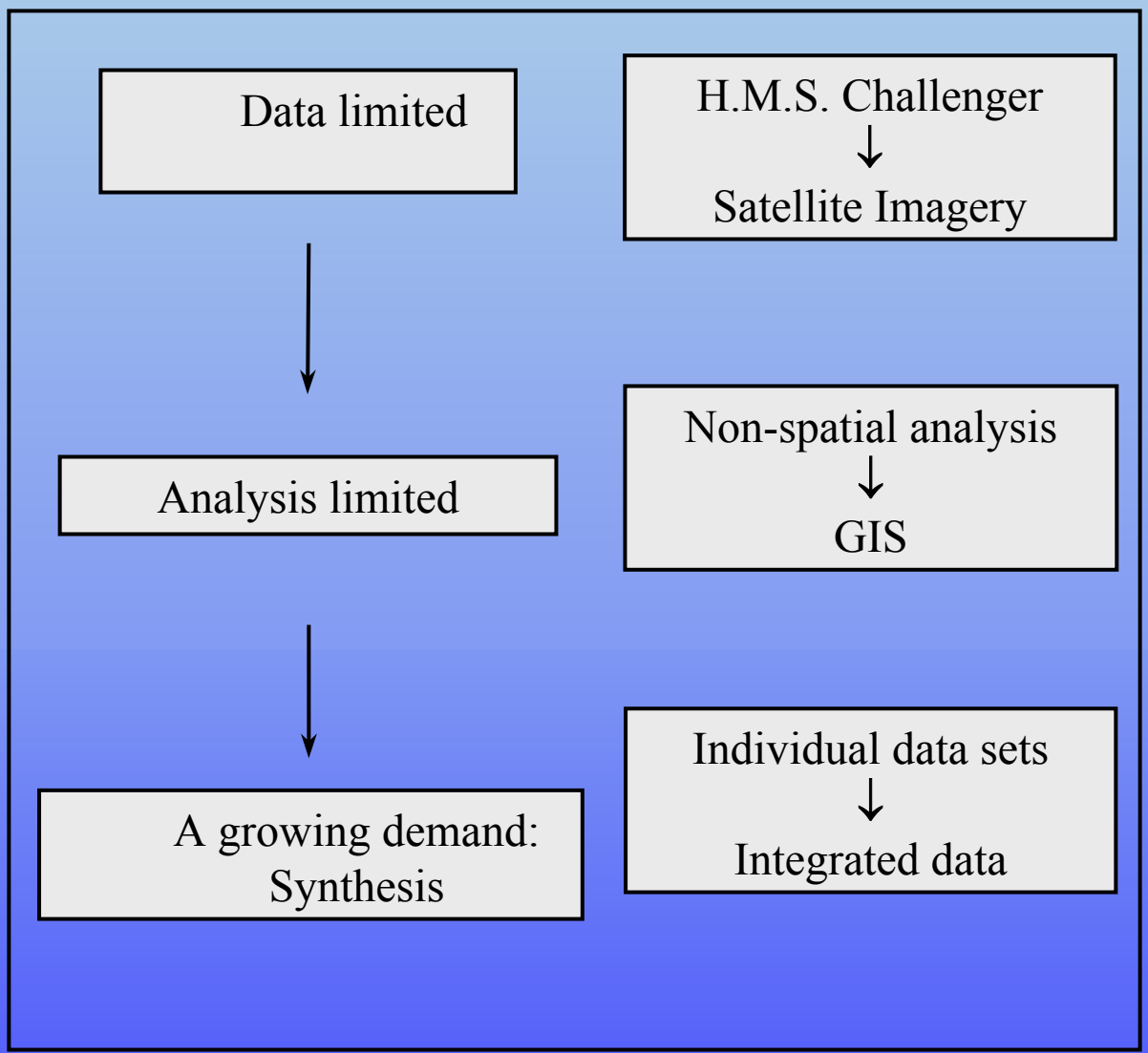
Gulf of Maine Mapping Initiative



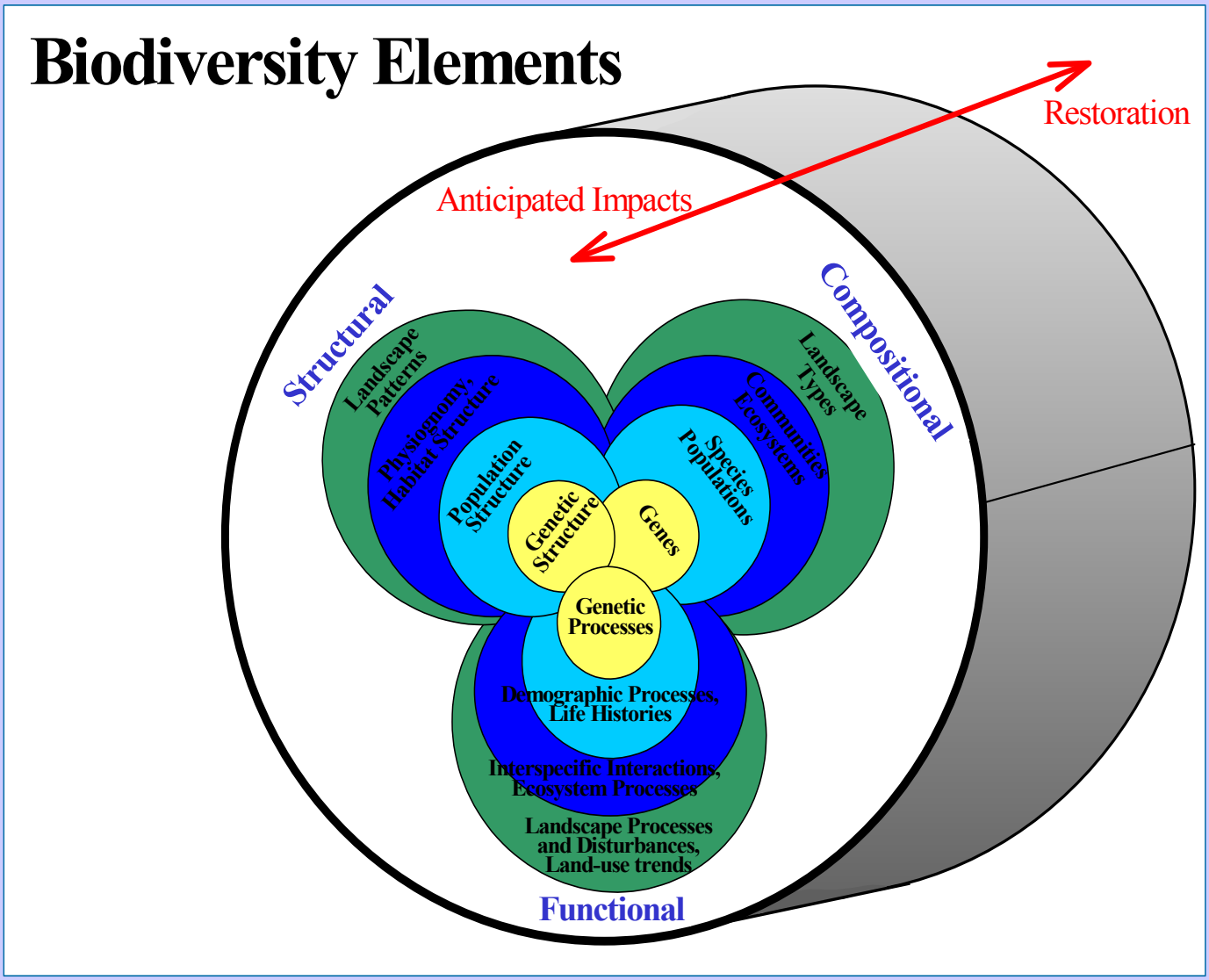

GULF OF MAINE COUNCIL
CANADA
UNITED STATES
GOMMI Steering Committee
GOMMI Administrative & Contracting Office
DFO
GSC
USGS
NOAA
State/Province Agencies
Academia, Others
Regional Advisory Committees
GOMMI Mapping Office U.S. & Canada
Research & Technical Advisory Committees

What do we want from GIS?

Synthesis.



Multiple levels of complexity to describe habitat



Source: Barkman, 1978; Franklin, 1988; Noss, 1990

Figure adapted from Barkman (1978) Franklin (1981), and Noss (1990).

e.g.

Functional

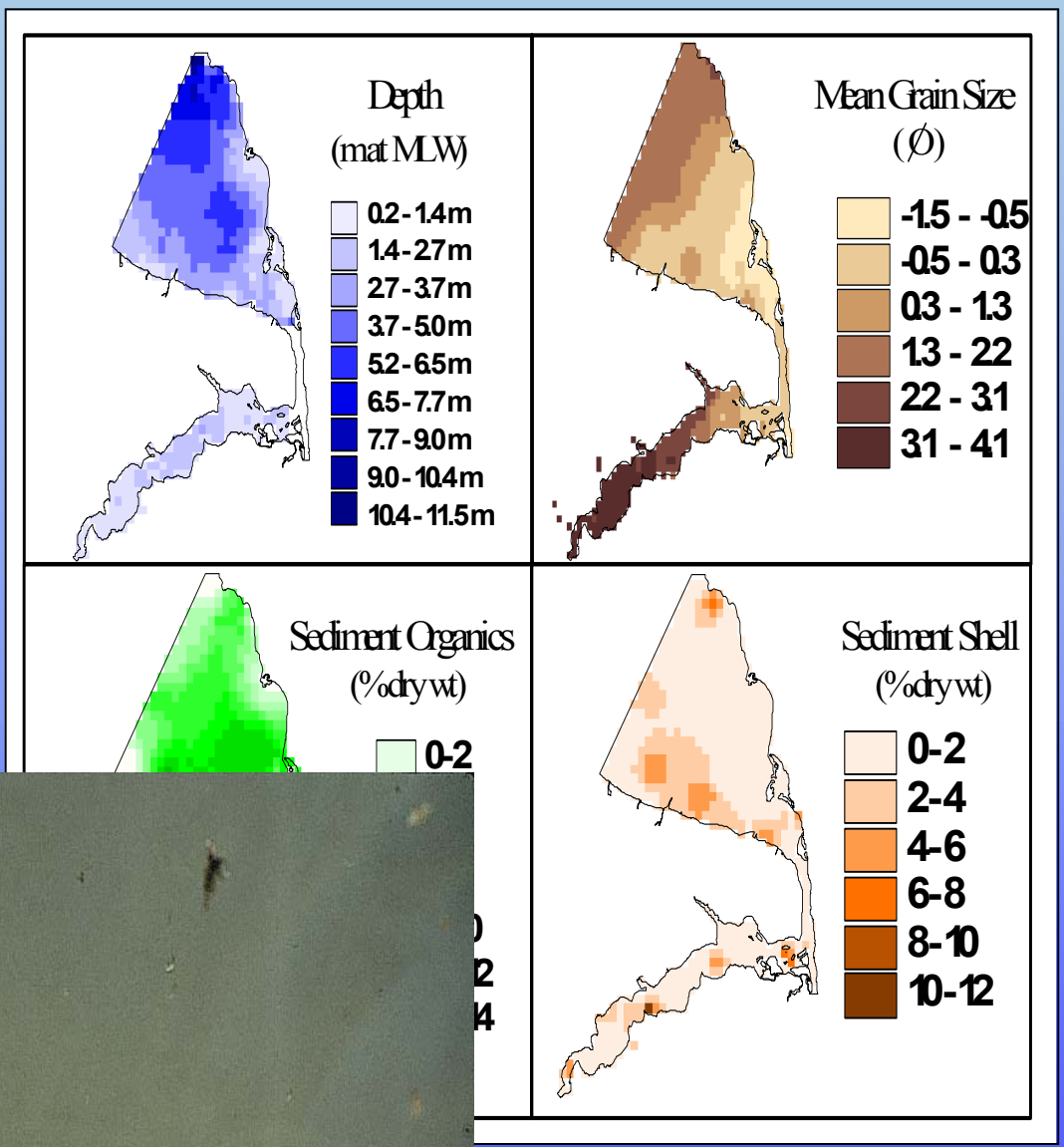
Seascape Processes and Disturbances, currents, tides, gyres, mixing depth, entrainment, event frequencies and intensities, fisheries

Interspecific Interactions, Ecosystem Processes: succession, predation, competition, commensalism, mutualism, parasitism, disease, functional groups of species or taxa, stability vs. habitat disturbance, nutrient cycling

Demographic Processes, Life Histories: migration, recruitment, survivorship, behavior

Genetic Processes: mutation, gene flow, island effects, non-random mating, inbreeding depression, gene expression

Integrate Laboratory with Field Studies



Pelagic Habitat
Large-scale pelagic coupling

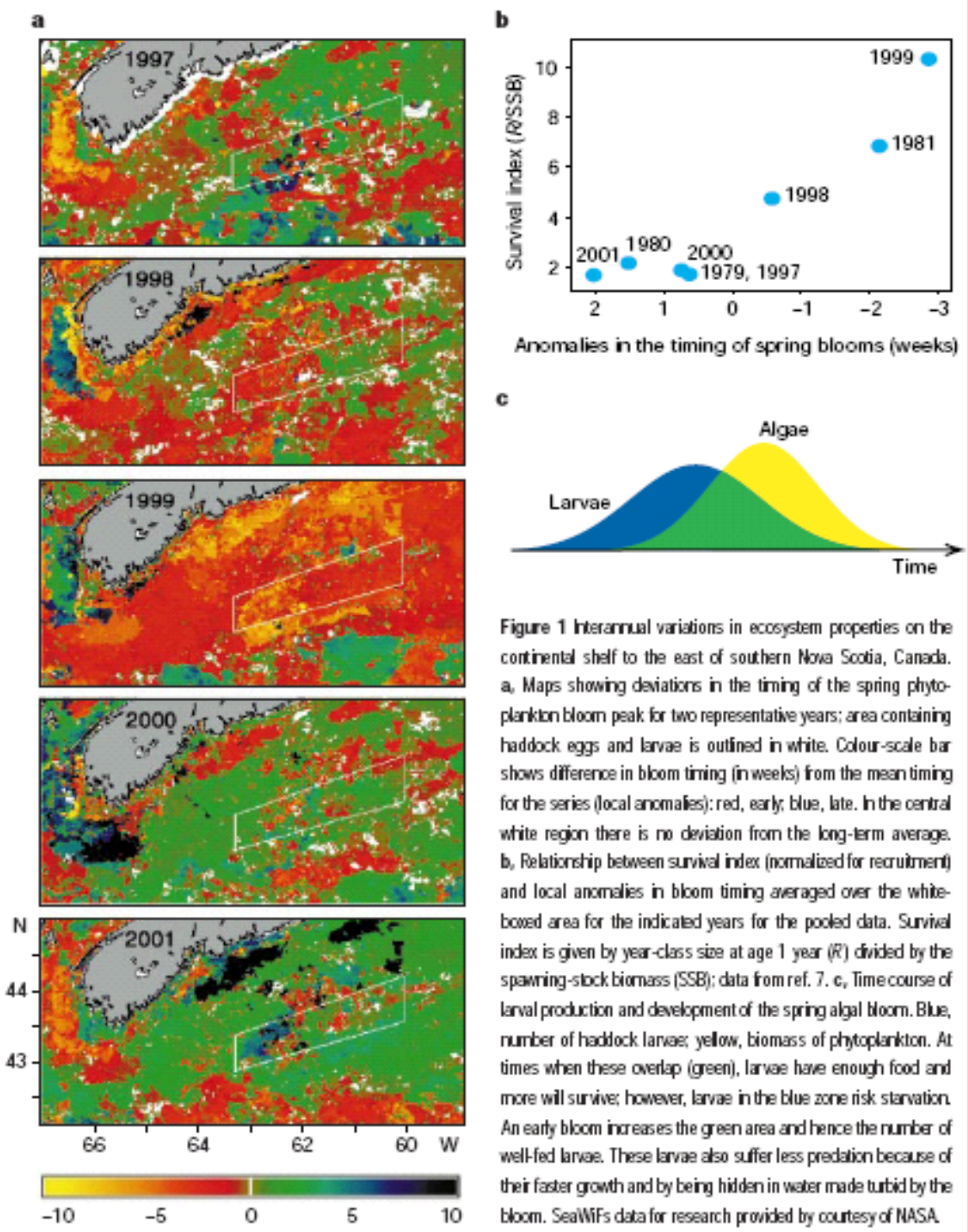
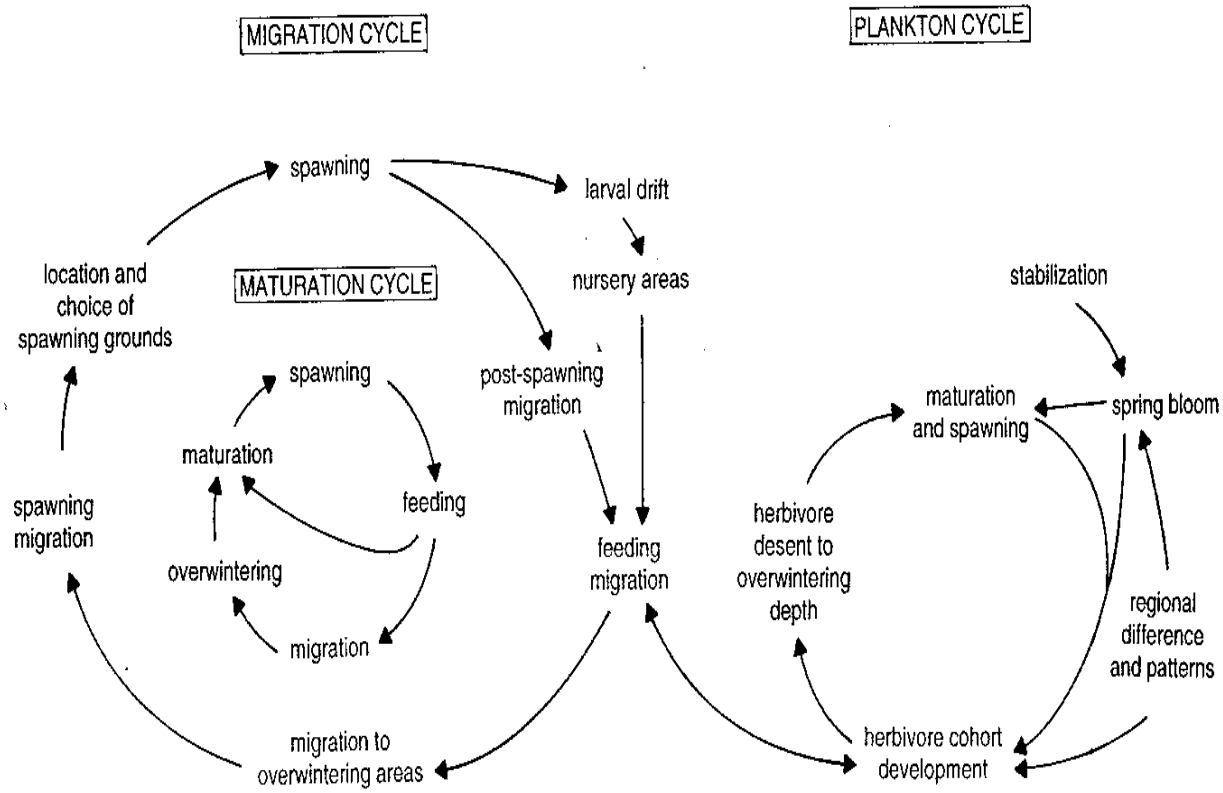


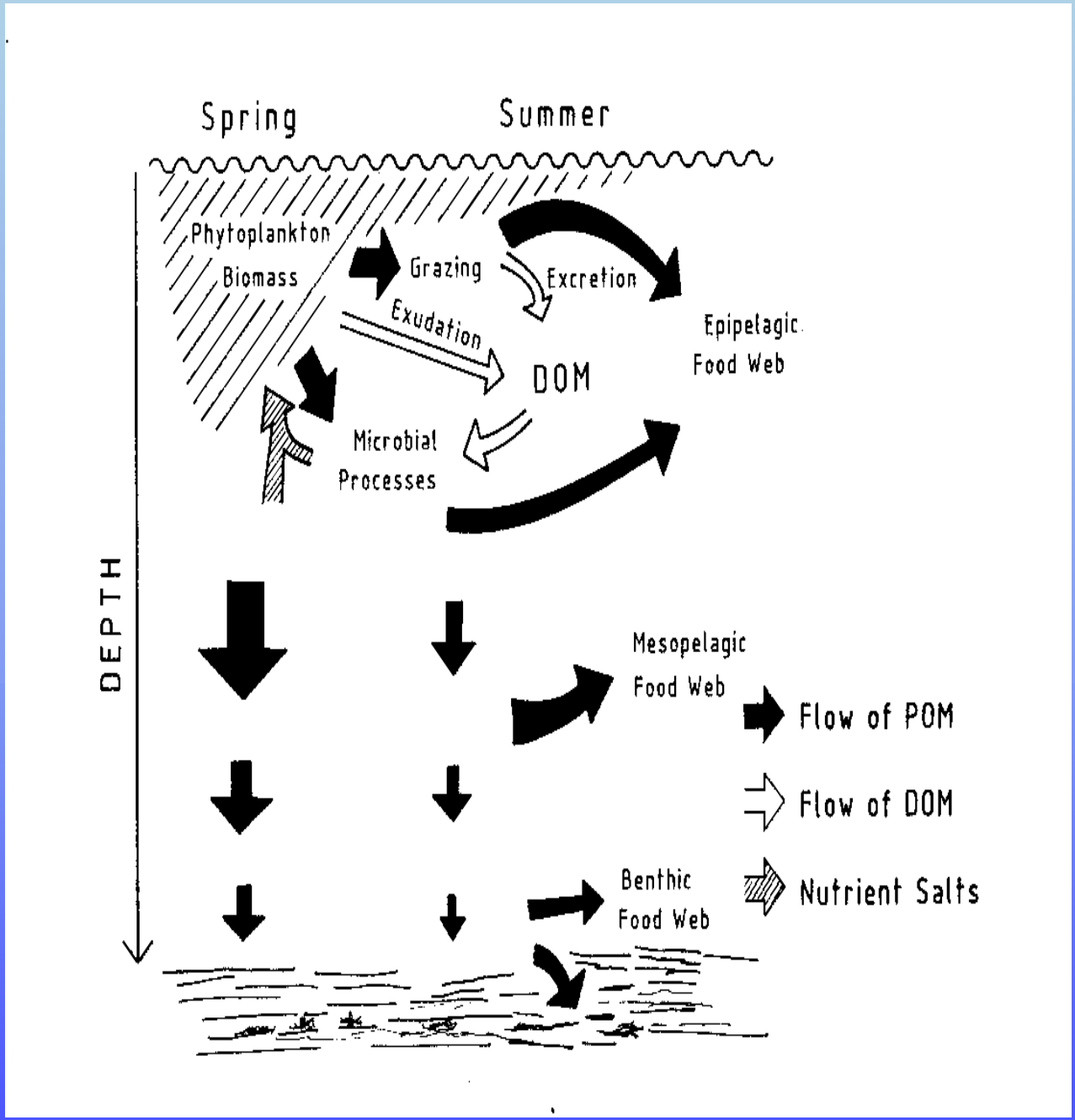
Figure 1 Interannual variations in ecosystem properties on the continental shelf to the east of southern Nova Scotia, Canada. a, Maps showing deviations in the timing of the spring phytoplankton bloom peak for two representative years; area containing haddock eggs and larvae is outlined in white. Colour-scale bar shows difference in bloom timing (in weeks) from the mean timing for the series (local anomalies): red, early; blue, late. In the central white region there is no deviation from the long-term average. b, Relationship between survival index (normalized for recruitment) and local anomalies in bloom timing *averaged* over the white-boxed area for the indicated years for the pooled data. Survival index is given by year-class size at age 1 year (R) divided by the spawning-stock biomass (SSB); data from ref. 7. c, Time course of larval production and development of the spring algal bloom. Blue, number of haddock larvae; yellow, biomass of phytoplankton. At times when these overlap (green), larvae have enough food and more will survive; however, larvae in the blue zone risk starvation. An early bloom increases the green area and hence the number of well-fed larvae. These larvae also suffer less predation because of their faster growth and by being hidden in water made turbid by the bloom. SeaWiFs data for research provided by courtesy of NASA.

Platt et al. 2003

Pelagic Habitat
Large-scale pelagic coupling



Benthic-Pelagic Coupling

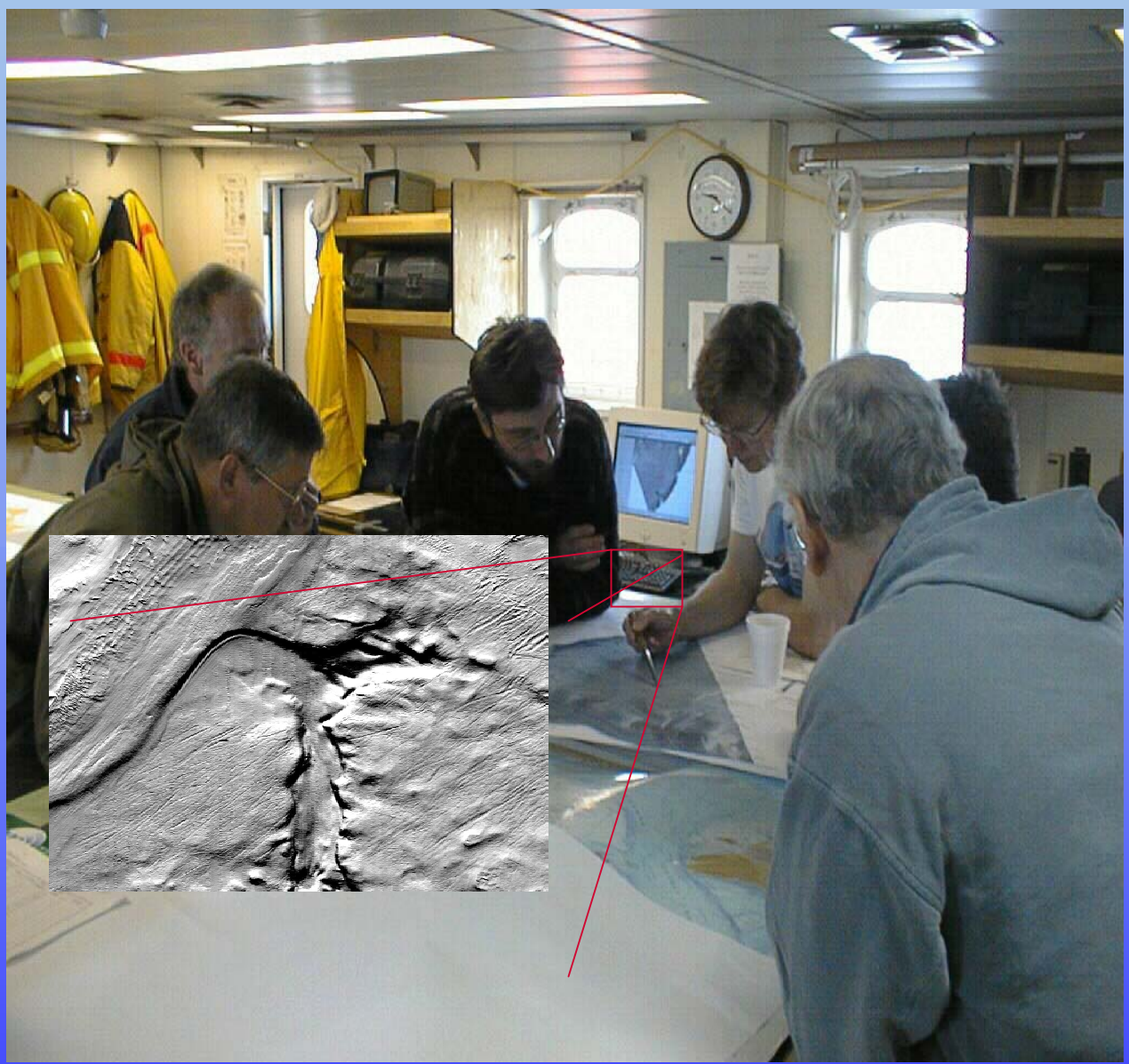


Monitoring

Develop sampling and monitoring strategies

Sampling resolution	Methods	Data acquisition speed	Sampling density
Coarse scale (10-1000+ km^2)	Multibeam, satellite, CASI, LIDAR	Rapid	Complete
Medium scale (10-100 km^2)	Video, sidescan sonar, interferometric sidescan sonar, laser line scan	Moderate	Selected continuous transects
Fine scale (1-10 m^2)	Still photography, grab samples, tidepool/beach inventories	Slow	Discrete points

.. and implement them



Daily operational planning with multibeam and backscatter maps.

Management Advice

Biodiversity & Gear Effects & Hot Issues

2. UTGAVE

Adresseavisen

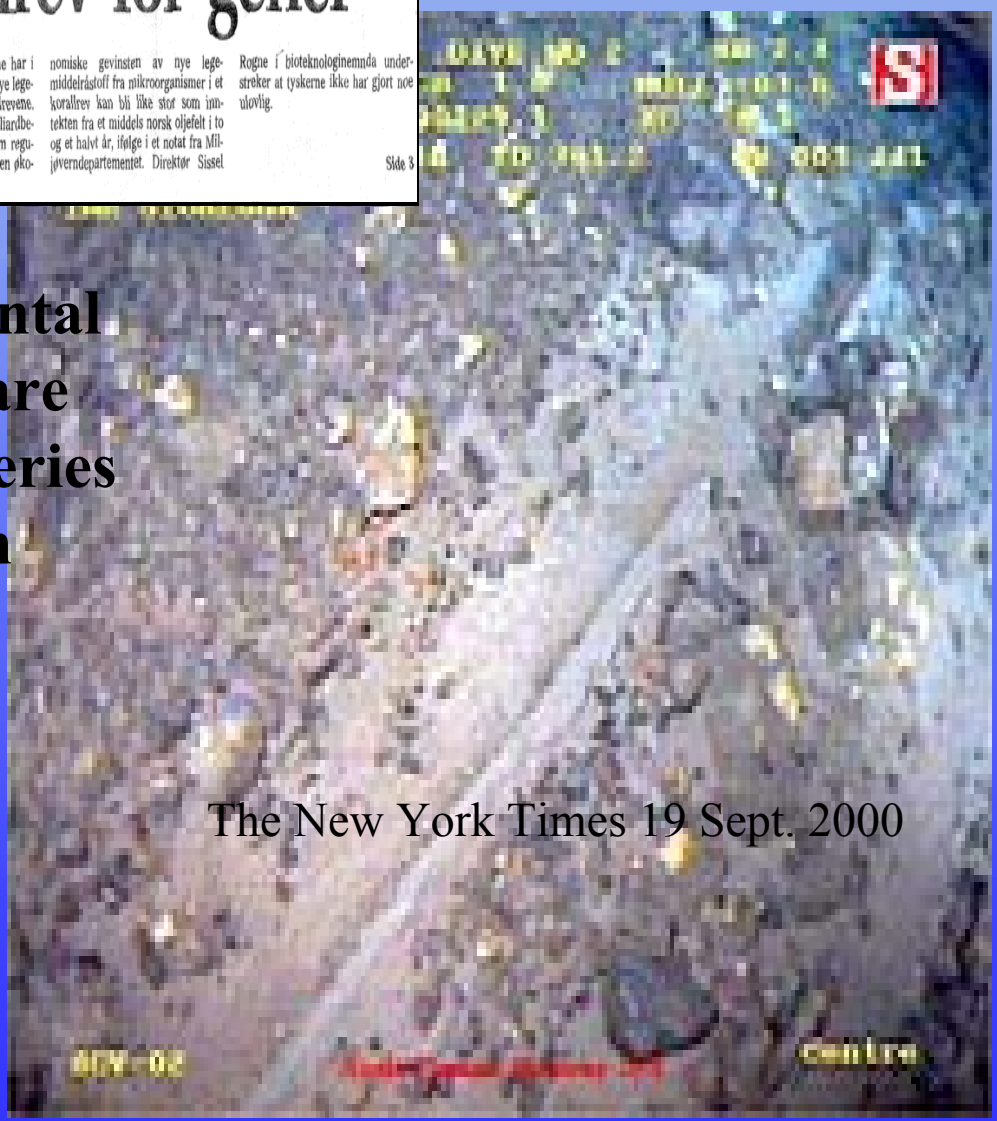
3. desember 1999 Uke 48 Nr. 280 233. årgang FREDAG Løssalg kr. 10. Utenfor Midt-Norge kr. 12

Ribber korallrev for gener

Korall og svamp fra revene på Sularyggen utenfor Frøya kan inneholde enzymer som har gunstig effekt på immunforsvaret hos mennesker. Gen-forskere fra tyske universiteter har kastet seg over «gullgruven» utenfor trøndelagskysten. Forskerne har i fem år dykket etter råstoff til nye legemidler som kan finnes i korallrevene. Norge står i fare for å tape milliardbeløp, fordi vi mangler lover som regulerer uttak av gen-ressurser. Den økonomiske gevinsten av nye legemiddelråstoff fra mikroorganismer i et korallrev kan bli like stor som inntekten fra et middels norsk oljefelt i to og et halvt år, ifølge i et notat fra Miljøverndepartementet. Direktør Sissel Rogne i bioteknologinemnda understreker at tyskerne ikke har gjort noe ulovlig.

Side 3

Environmental concerns are driving fisheries research

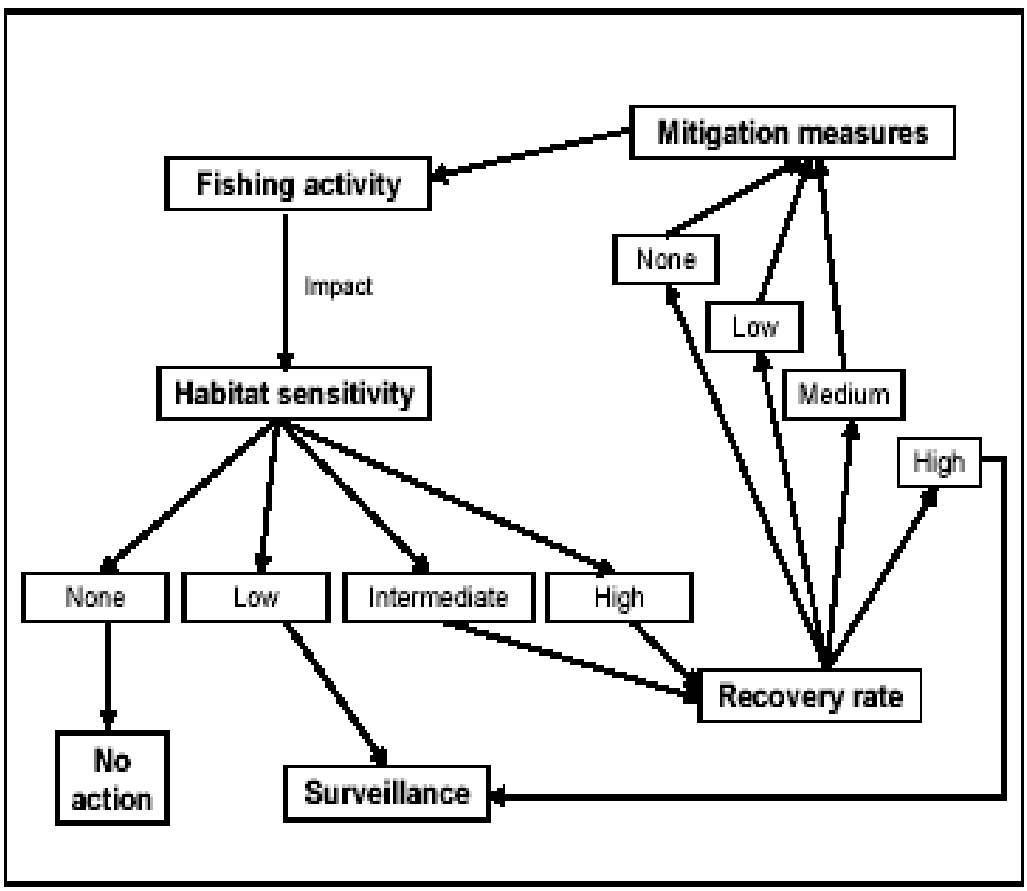


The New York Times 19 Sept. 2000

Modeling

- Risk Assessment
- Habitat suitability
- Habitat vulnerability
- Habitat recoverability
- Ecosystem services

Figure 9.6.1.a. Potential decision tree relating the impact of fishing activity on habitats to management advice.



Core parameters

Large-scale circulation
Primary producers
Secondary producers
Fish distribution
Fishing effort
Other human activities
Bathymetry
Acoustic backscatter
Surficial geology
Benthic composition
Issues, e.g. cold-water corals
Mgt. actions, e.g. closures, HAPCs
Photographic documentation

Current actions

- NEFSC – Sea Grant GIS / Mapping coordination
  - Identify partners / stakeholders
  - Prioritize issues
  - Ensure data access and exchange (incl. propriety issues)

- NE Habitat Evaluation working group (Fishery Councils, ASMFC, NERO, NEFSC)
  - Evaluate existing models elucidating ecosystem services
  - QA/QC of state data via ACCSP

- GOMMI
- ICES, WGMHM, WGECO, WGFISH
- Charleston, Sept 2004